

Human Factor and Sustainable Energy Consumption in Restaurants: A Review

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Abstract

The restaurant is one of the components of the food service industry with high energy demand. The sustainability of its energy consumption is highly desirable for profitability and climate change mitigation. 'Human factor' is a phenomenon that is difficult to control in all businesses including the restaurant, and it unfortunately coordinates all other resources. This article reviewed the effects of human factor on sustainable energy consumption, to provide information that will aid better restaurant management towards sustainable operations. A scoping review was employed for the study. Many published articles including grey literature were consulted, but only those with related content were included in the study. The articles were grouped according to several themes capturing issues relating to human factors and the various effects were identified. The study found energy literacy and awareness, behavioral intentions and attitudes, social norms and cultural influences, training and employee engagement, and customer perceptions, expectations, and preferences to be among the human factor issues that affect energy sustainability behaviors. Relevant lessons were drawn from the findings of the study to help restaurants navigate the human factor issues toward sustainable energy utilization. This paper provides information relevant for policy and on-ground administration of restaurants towards enhancing the sustainability of restaurants' operations. Enhanced energy sustainability in restaurants will contribute greatly to the drive towards climate change mitigation and its consequential benefits.

Keywords: Restaurant, Human Factor, Energy Consumption, Sustainability, Food Service.

Introduction

The restaurant is one of the most important subsectors of the food service industry with huge economic and social benefits; it creates jobs, generates revenue for the owners and government (tax); it impacts public health, environmental sustainability, and social equity (Kitchenbarfieldingslocal, 2023; Moutray, 2024). Because of its exceptionally high energy demand, the restaurant is a significant contributor to global energy use in commercial buildings (Bisu *et al.*, 2024; Corigliano and Algieri, 2024); it consumes averagely 5 – 10 % more energy than other commercial buildings (EnergyStar, nd). As a result of the increasing awareness of climate change and environmental degradation, restaurants are under

pressure to adopt sustainable energy practices. Sustainable energy consumption refer to carrying out all activities from acquisition through utilization of energy and other resources in a manner that can be sustained without jeopardy to the physical and social environment, while achieving the economic goals of the business (Murphy, 2025). Those activities, in spite of technological advancement, require the input of humans.

The restaurant consists of a group of people performing different roles to achieve the common goal of providing food to a heterogeneous group of clients. Hence, the restaurant operation can be said to be communal in nature. The theory of planned behavior may therefore be useful in understanding the actions of individuals and groups in the restaurant towards sustainable energy consumption. This theory proposes that an individual's behavior is controlled by his intentions, which govern the motivational factors (Aizen, 1985). It consists of three variables namely: Personal attitudes towards a particular behavior (the individuals' knowledge, attitudes, prejudices and feelings about the particular behavior), subjective norms (the individuals views of the idea or beliefs of others about a particular behavior), and perceived behavioral control [the extent to which the individual believe they can control their behavior, which depends on how they perceive internal factors such as support and resources available to them] (Aizen, 1991) So, if the individual perceives that the community approves of a particular behavior of which he is knowledgeable and feels good about it, then the chances of exhibiting that behavior becomes very strong. This theory suggests that the individual or group have control over their behaviors, and can decide to do whatever they deem fit; so they only need to be convinced to believe in the right thing.

However, this community (the restaurant staff, management and customers) are subject to various physiological, psychological and environmental (Physical and social) influences that depend on certain temporary or permanent conditions beyond their control. This scenario can be referred to as 'the situation' (Aunger, 2020). The situation can affect the decisions, actions and interactions of the individuals/group, which can in turn influence the operations of the restaurant where they work (Kuhe and Bisu, 2020). These therefore draws attention to the necessity of understanding those human related factors that are capable of influencing sustainable energy consumption in the restaurant, if the goal of sustainable operations must be achieved.

Although there is a growing quest for non-contact services that does not require human intervention in restaurants, its full deployment is still far in developing countries like Nigeria and, humans cannot be completely eliminated in the restaurant industry; hence they are an important aspect of the business (Jang, 2021). Research has shown that human factor, which refer to issues that have to do with physiological, attitudinal, or behavioral influences such as energy literacy, behavioral intentions, and social norms, play a crucial role in shaping energy consumption patterns in restaurants (Steg *et al.*, 2015).

Despite the importance of human factor in sustainable energy consumption, studies on the existing literature on this subject are scarce. This is capable of delaying its understanding

among energy consumers, hence undermining its effects and therefore sustaining losses in operations. Outfits such as restaurants require knowledge provided by such studies as this to enhance their energy related operations. This study therefore sought to clarify those specific areas where human factors can influence energy utilization in the restaurant, to provide guidance for policy makers and managers for actions that will enhance sustainable energy consumption in the restaurant. This departs from previous research that have hitherto dwelled on technical factors only, such as use of efficient equipment, design of kitchen, etc.

This study provides an overview of the current state of knowledge on the human factors influencing energy consumption, including:

- a. Energy literacy and awareness among restaurant staff and customers;
- b. Behavioral intentions and attitudes towards energy efficiency;
- c. Social norms and cultural influences on energy consumption;
- d. The impact of training and employee engagement on energy savings;
- e. Customer perceptions, expectations and preferences.

DeWaters and Powers (2011) defined energy literacy as the sphere of basic energy-related knowledge, in combination with an understanding of the environmental effects of energy generation and consumption, how energy is used in everyday life and the adoption of energy-saving behaviors. This definition combines three different dimensions: knowledge, attitude and behavior. Knowledge influences attitude, while attitude influences behavior (Appiah *et al.*, 2023). This is necessary for any meaningful progress in sustainable operations; it is the key to any other action desired to be taken achieve sustainability.

One important way to achieve energy literacy is through employee training, which 'refers to the systematic process of enhancing the skills, knowledge, and competencies of employees to perform their jobs effectively and efficiently' (Noe, 2017). It involves providing a set of information and appropriate instruction and experiences that results in attitudinal and behavior modifications towards an identified goal. Another way to enhance energy literacy is through Employee engagement, 'a psychological state characterized by vigor, dedication, and absorption in work, leading to increased productivity and organizational commitment' (Schaufeli *et al.*, 2002); It involves connecting with the employees psychologically through involvement in thought and decision making processes to give them a sense of belonging in the enterprise or targeted goal.

Training plays various roles in preparing employees for desired service:

- Awareness and knowledge: Educating employees on energy-efficient practices and sustainability
- Skill development: Training employees on energy-saving techniques and technologies
- Behavioral change: Encouraging employees to adopt sustainable energy habits

Behavioral intentions can be defined as an individual's subjective likelihood of behaving in a specific manner, such as embracing energy-efficient practices (Murphy, 2024; Ajzen, 1991). Behavioral intentions are an important predictor of genuine conduct, as they embody an individual's inspiration and commitment to execute a specific action (Fishbein & Ajzen, 2010). 'Energy efficiency attitudes' refer to an individual's evaluations of energy-efficient behaviors (positive or negative), such as preserving energy or deploying renewable energy sources for tasks (Eiser et al., 2012). The Energy efficiency attitudes are influenced by several factors, including environmental concerns, economic motivations, and social norms (Abrahamse *et al.*, 2005). These attitudes affect behavioral intentions. They must therefore be taken seriously if behaviors must be changed or reinforced.

Another factor that affect behavior is 'Social norms'. They are the unwritten rules and expectations that direct behavior within a given group or society, influencing individuals' activities and judgments regarding various phenomena, including energy consumption (Nickerson, 2024; Cialdini, 2009). 'Cultural influences' shape the social norms of a community. Cultural influences refer to the common values, beliefs, and practices that characterize a community's energy consumption patterns and behaviors (Stephenson *et al.*, 2010). Three types of social norms have been identified:

- a. Descriptive norms: Perceptions of others' actions/activities [e.g., 'Most people in my neighborhood use energy-efficient appliances'] (Cialdini, 2009);
- b. Injunctive norms: Perceptions of others' approval or disapproval [e.g., 'My friends think it's important to reduce energy consumption'] (Cialdini, 2009);
- c. Subjective norms: Personal beliefs about others' expectations [e.g., 'I think my family wants me to conserve energy'] (Nickerson, 2024; Fishbein & Ajzen, 2010).

These are important factors because of the community nature of the restaurant. The behavior of one or more employees can affect that of others, especially when the management 'does not care'. Role models can have some great influence, good or bad, so there's a serious need for regulation and careful combination of employees.

'Customer perceptions' are the customer's subjective understanding and evaluation of a service, product, or experience, which depend on their individual experiences, attitudes, and biases (Kotler & Keller, 2016). These are a set of beliefs that a customer has already developed about a certain phenomenon because of their experiences in or away from the restaurant, and are capable of affecting their choices. 'Customer expectations' are those things or actions the customer desires to see or experience in a restaurant's product(s) or services, shaped by past experiences, marketing communications, and social influences (Oliver, 2014). 'Customer preferences' refer to a customer's relative liking or disliking of specific attributes, features, or characteristics of a product, service, or experience (Tversky & Kahneman, 1981). Customer perceptions shape their expectations and preferences, and restaurants must take note of these and plan their energy utilization to balance sustainability, customer retention, and profitability.

By synthesizing the existing literature, this review will identify key challenges, opportunities, and strategies for promoting sustainable energy consumption in restaurants, ultimately contributing to a more environmentally sustainable and energy-efficient food service industry.

Statement of the Problem

Although the effects of human factor have been proven to affect energy consumption in many ways, there are still no comprehensive reviews that synthesize the existing literature on this subject. This article therefore aims to fill this knowledge gap by exploring the effects of human factor on sustainable energy consumption, to help policy makers make policies that will address specific areas such as energy literacy, training, green certification, etc. it will also help restaurant managers to effectively incorporate matters like cultural norms, staff and community engagement into its activities to enhance energy performance.

Aim and Objectives of the Study

This study aims to enhance energy sustainability in the restaurant by encouraging knowledge based decision making. It seeks to provide lessons for restaurants based on information obtained from literature on the effects of human factor on energy consumption. The specific objectives of the study include:

1. To identify the various areas in which human factor affect energy consumption in buildings/businesses;
2. To derive lessons relevant to the restaurant, considering its peculiarities.

Significance of the Study

This paper provides information relevant for policy and on-ground administration of restaurants towards enhancing the sustainability of restaurants' operations. Enhanced energy sustainability in restaurants will contribute greatly in the drive towards climate change mitigation and its consequential benefits.

Methodology

The methodology employed for this study is the exploratory scoping review. Scoping review is a type of evidence synthesis that aims to systematically identify and map the breadth of evidence available on a particular concept, or issue, often irrespective of source (Munn *et al.*, 2022). It was especially chosen because of its characteristics (Micah *et al.*, 2021) which include

- Broad research question or topic;
- Inclusive criteria (e.g., no limitations on study design, language, or publication date);
- Comprehensive literature search (multiple databases, grey literature, etc.);

- Study selection based on relevance and scope;
- Data extraction and charting (organizing and summarizing data);
- Narrative summary of findings.

Furthermore, the following advantages of scoping review made it more attractive for the present study:

- It provides a comprehensive overview of the literature;
- It identifies research gaps and areas for further investigation;
- It informs the development of research questions or hypotheses;
- It facilitates the planning of future research studies (Micah *et al.*, 2021)

The terms and phrases such as 'human factor', 'energy literacy', 'behavioral intentions', 'customer perception', 'energy sustainability', 'restaurant energy', 'social norms', etc were searched in various data bases such as google scholar, Scopus, web of science, directory of open access journals, ScienceDirect, AgeLine to identify published literature, including journal articles and grey literature. Articles containing information relating to any of the themes stated in a – e or discussed energy sustainability were included in the study. The various issues relating to human factor in energy consumption were categorized into themes to include a – e stated in the introduction. Each literature relating to each theme were studied to identify its influences on sustainable energy consumption. Each article passed through a selection process (Figure 1) as outlined by Peters, *et al.* (2015)

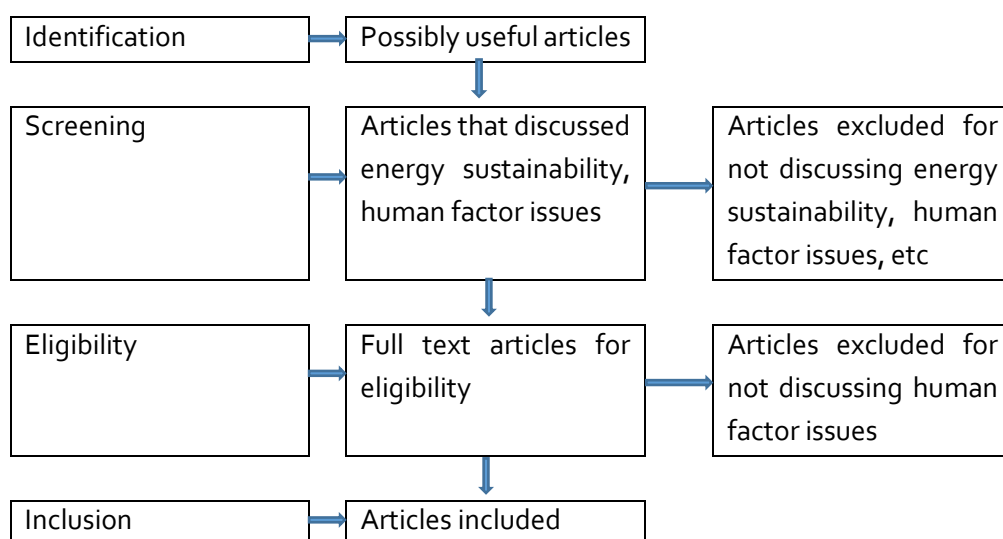


Figure 1: Selection process

Results and Discussion

The results of the study are presented below. Table 1 shows the various themes and the number of articles that discussed each of them. The distribution seemed similar, indicating that they have attracted similar attention, or they are closely related and will require a

wholistic approach in finding solutions to them. Figure 2 shows the flow diagram for the screening of the articles for the study.

Table 1: Study themes

SN	Theme	No. of Articles
1	Energy Consumption activities in restaurants	2
2	Energy literacy and awareness	6
3	Behavioral intentions and attitudes	6
4	Social norms and cultural influences	7
5	Training and employee engagement	4
6	Customer perception, expectations and prejudices	5
7	Total	30

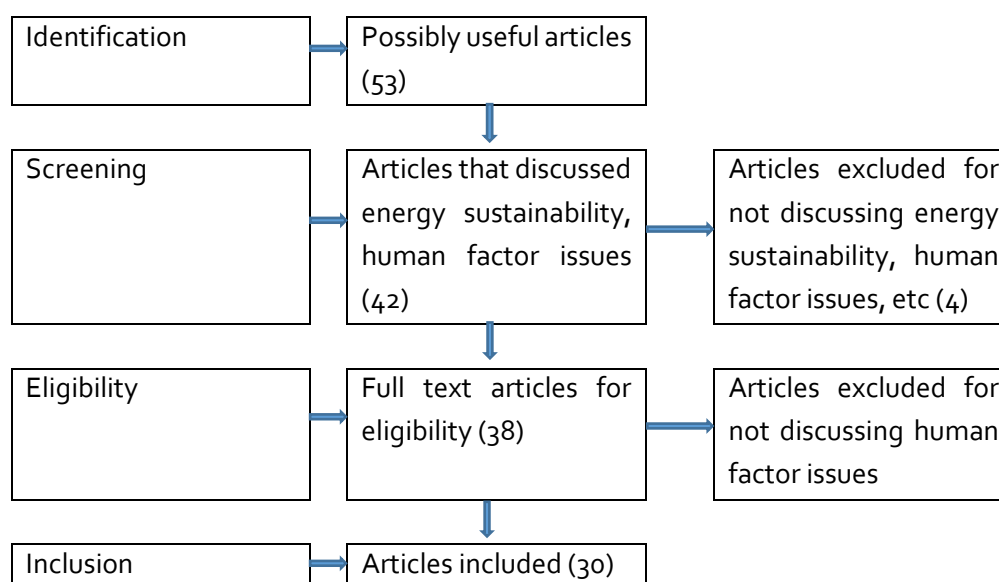


Figure 2.

Energy Consumption Activities in Restaurants

The major energy-consuming activities in a restaurant are presented in Fig. 3 along with the average proportion of energy consumed by each (Constellation, nd). The figure shows that food preparation is the highest energy consumer with 35 %, followed by heating, ventilation and air conditioning with 28 %. Sanitation, lighting, and refrigeration consume 18 %, 13 %, and 6 % of the restaurants' energy respectively. Any energy sustainability measures taken by the restaurant must address these areas and other miscellaneous activities associated with them (Constellation, nd), with priorities allocated according to the magnitude of energy consumption of the activities. All the identified areas are associated with human

activity, making them open to human factor effects. All the human factor effects identified by a-e in the introduction are related to one or more of these. Other miscellaneous energy consuming activities may however exist, but their number and magnitude will depend on location and other peculiarities of specific restaurants.

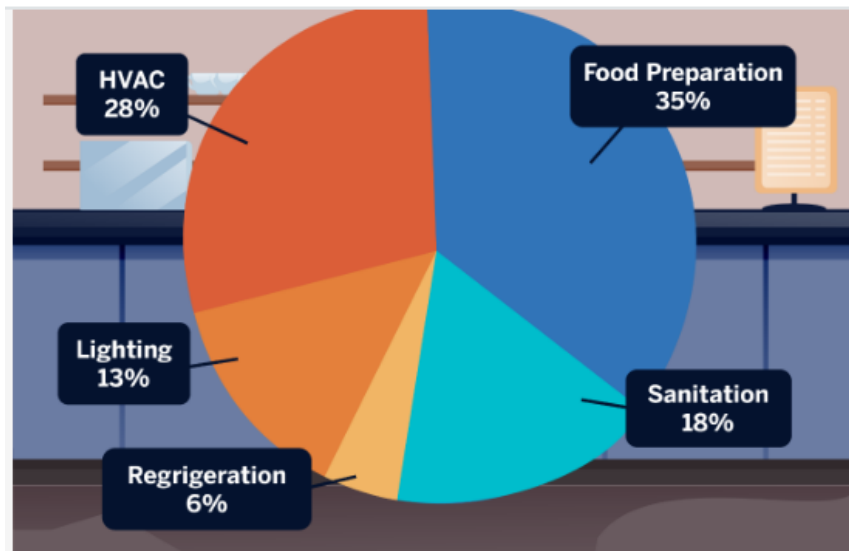


Figure 3: Energy consumption activities in restaurants (Constellation, nd).

Effects of Human Factor on Sustainable Energy Consumption

The effects of human factor on restaurant energy consumption are summarized in Table 2.

Table 2: Effects of human factor on Sustainable Energy Consumption

Human Factor Theme	Effects on Sustainable Energy Consumption	Reference
Energy literacy and awareness among restaurant staff and customers	Good energy literacy among management and staff has proved to enhance sustainable energy behavior, improving profitability and environmental safety. Its absence however results in poor energy sustainability decisions and behaviors.	DeWaters and Powers (2011); Appiah <i>et al.</i> (2023); Hans & Cudjoe (2020); Gao, <i>et al.</i> (2017); Oriade <i>et al.</i> (2021);
Behavioral intentions and attitudes towards energy efficiency	Employees' behavioral intentions Have shown significant mediation effect on energy-saving attitude, the subjective norm, and perceived behavioral control of their energy-saving habit. Social interventions such as modelling (providing role models for staff) have shown to help in changing behaviors towards sustainable energy practices. The communal nature of restaurants was especially contributory in this regard. Exemplary leadership is therefore important for sustainable energy utilization to thrive in a restaurant, especially in developing countries like Nigeria where businesses suffer poor employee retention due to poor remuneration and underemployment.	Cudjoe (2020); Gao, <i>et al.</i> (2017); Wang & Li (2021); Chen & Chen (2021); Staddon <i>et al.</i> (2016)
Social norms and cultural influences on energy consumption	It has been observed that personal norms were positively related to support for renewable energy transition, but poor leadership can cause it to turn otherwise. Some people, regarding some meals as traditional, prefer those prepared using unsustainable methods and equipment such as open fires; some cultures forbid cooking while standing so even if a cooking technology is sustainable, it may not be used due to cultural barriers – these discourage sustainable energy practices, and may depend on location. Enlightenment campaigns, public education and good customer relations will help in this direction. Restaurants may develop wall charts and leaflets and place them strategically in dining halls to persuade customers to accept certain products, thereby balancing patronage and sustainable practices. The use of role models is also important here.	Kuhe & Bisu (2020); Wang & Lin (2017); Chan, <i>et al.</i> (2022); Allcott (2011); Staddon <i>et al.</i> (2016)
The impact of training and employee engagement on energy savings	Training and employee engagement has been found to impact them in various ways: • Motivation and commitment: Encouraging employees to engage in and be passionate about sustainable energy practices. • Participation and involvement: It allows employees to get involved in energy-saving initiatives and decision-making. • Communication and feedback: It keeps the staff informed and enables them provide feedback on energy consumption and savings. • Recognition and rewards: it helps the employer to create Incentives for sustainable energy behaviors. All these encourage sustainable energy behavior, hence the sustainable operation of the outfit with benefits such as good reputation, savings on energy consumption, contribution to sustainable future, compliance with energy regulations and standards.	Oriade <i>et al.</i> (2021); Giday & Elntheraiyan (2023); (Alzyoud, 2021)
Customer perceptions, expectations, and preferences	Customers' perception of sustainable practices in a restaurant have shown to affect their patronage of the restaurants. Some customers were willing to pay higher for meals or services provided through sustainable practices, thereby encouraging sustainable energy practices. However, some people prefer the use of some specific technologies which are not sustainable for food preparation, thereby demeaning the value and practice of sustainability; they claim aroma, food taste, etc. Research in developing fuels that will produce such traditional aroma and tastes in a sustainable manner will help in this direction. Also, perception enhancement efforts such as awareness campaigns will also go a long way to help in resolving the negative effects.	Sarmiento & Hanandeh (2018); Sattari <i>et al.</i> (2018); Kuhe & Bisu (2020)

Source: Study result

Implications for the Restaurants

The restaurant is an outfit with high energy demand and operationally dependent on people as employees and customers. Its operational sustainability, though very important, is susceptible to human factor effects because of its communal nature. The following lessons are therefore important for the restaurant as far as sustainable energy operation is concerned.

1. The importance of energy literacy has been highlighted and must be taken seriously. Restaurants must take steps to raise the awareness of its management and staff on issues of energy management and its importance in sustainable operations. In-house workshops, conference attendance, publishing of operational guidelines, and wall posters in operational areas can be used to educate and remind staff about the importance of and beneficial steps towards sustainable energy utilization.
2. The power of social modelling on behavioral intentions have also been found to be of great impact in energy saving behaviors. This implies that exemplary leadership is very important in the restaurant due to its communal nature. If leaders in the management and operational areas of the restaurant exhibit well sustainable energy behaviors, their subordinates will definitely learn by imitation, and a good culture of energy behavior will be developed. This will reduce the efforts required to enforce sustainable energy behaviors in the restaurant. Exemplary leadership can be achieved by personal discipline and adherence to rules and regulations, and adherence to codes, standards and best practices. Incentives can also be created to encourage good behaviors towards energy sustainability, for example meeting a set energy saving with a set standard of service delivery to attract a percentage of the saving as a gift/award.
3. Social norms and cultural influences have been shown to influence energy consumption behavior in several outfits. It is therefore important for the restaurant to be conversant with the social norms and cultures of its location and design its systems to accommodate them and reduce their effects. Systems here refer to equipment and operational procedures and codes. Where the norms and cultures extremely affect sustainable energy consumption or operation generally, the restaurant can employ community engagement and awareness campaigns and pasting of educational posters on their walls as part of decorations. Sustainable traditional practices and artifacts can also be employed to attract the locals while saving energy.
4. The impact of training and employee engagement has been shown to affect energy saving behavior. This means that poorly trained staff can perform badly and incur excessive energy costs for the restaurant. Also, trainings provided without attention to the needs of the staff will also yield bad results. Therefore, staff and management of the restaurant should engage to design relevant training programs

that will enhance attitudes and behaviors, and ultimately enhance performance towards energy sustainability.

5. Customer perceptions, expectations and preferences must be put into consideration while designing and executing products and services in a restaurant. Measures must be taken to avoid things that will irritate or expel customers. This can be achieved by a thorough understanding of the people of the locality where the restaurant is sited. A good customer care unit must be knowledgeable enough to design customer retention programs that will not hamper sustainable operations of the restaurant.

Conclusion

This study sought to identify the effects of human factor on energy sustainability with the aim of providing lessons for the restaurant towards sustainable energy utilization. The study has established that human factor has great influence on energy consumption of businesses, particularly the restaurants. This effect covers both staff and customers of the organizations, bothering on training, perception, cultural influences, etc. The results has exposed the limitation of traditional approaches that dwelled only on technological issues. The restaurant must therefore take note of these issues and make provisions to accommodate them in its planning and operations in order to operate sustainably. Furthermore, the result has opened a new chapter in energy policy formulation. Policy and other sustainability enhancement actions should integrate these human factor issues in addition to technological and economic factors. Policy instruments may include measures to encourage staff/customer engagement, energy literacy, integration of social norms and Cultural values in daily operations of restaurants. Further studies should focus on the dynamics of human factor influence on energy consumption. This should establish the specifics that may warrant mathematical modelling of such influences for better analysis.

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